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The Aesthetics of Behavioral Arrangements

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With their origins in scientific validation, behavior-analytic applications have understandably been developed with an engineering rather than a crafting orientation. Nevertheless, traditions of craftsmanship can be instructive for devising aesthetically pleasing arrangements—arrangements that people will try, and having tried, will choose to continue living with. Pye (1968) provides suggestions for this, particularly through his distinctions between workmanship of risk versus workmanship of certainty, and the mating of functional precision with effective or otherwise pleasing variability. Close examination of woodworking tools as well as antique machines offers instructive analogues that show, for instance, that misplaced precision can be dysfunctional when precision is not essential to a design. Variability should be allowed or even encouraged. Thus, in the design of behavioral contingencies as well as of practical or purely aesthetic objects, "precise versus variable" is not necessarily a distinction between good and bad. More generally, behavior analysts would do well to look beyond their technical experience for ways to improve the aesthetics of contingency design while continuing to understand the resulting innovations in relation to behavior-analytic principles.

Key words: aesthetics, acceptability of behavioral techniques, precision, variability, workmanship

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The attractiveness and acceptability of an arrangement are just as integral to that arrangement as are the results it can produce.

In addressing practical problems of social concern, a major priority for behavior analysts is to continually assess and improve the effectiveness of the techniques or combinations of techniques that comprise an intervention. As is proper in any applied science, the predictability and the reliability of outcomes are paramount. In best practice, a behavior-analytic technique or package is offered for general use only after it has been thus validated. Then, when introducing the results of such endeavors to the general public, we tend to advocate them with descriptions and arguments that emphasize the same criteria that are used for convincing ourselves and the scientific community in the initial validation. We often have been disappointed when our demonstrably effective approach has not been adopted with enthusiasm, or even has been rejected without trial. Most troubling, sometimes a carefully crafted educational technique or treatment package has been used and then discarded, or has been adopted but degraded when in use, either through direct opposition from administration or staff members or from losses of rigor in application that compromise the features that are crucial to its effectiveness.

Although some of those rejections or degradations may arise from conflicting ideology, this is not necessarily the case, as illustrated by a well-known example involving typewriter keyboards. The QUERTY keyboard configuration has remained standard, even through the replacement of typewriters with computers, and even though it is demonstrably inferior to any of several alternative keyboard configurations. Persistence of preexisting practice is surely understandable in behavioral terms—whether appealing to behavioral momentum or more simply to the difficulty of replacing an already established repertoire with an incompatible,

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but in the long run, more effective one. I personally changed to a new, more powerful word-processing program only reluctantly, under contingencies of the workplace that bordered on coercion. Often, however, one arrangement is favored over another irrespective of its effectiveness simply on the basis of how it looks or whether it seems "user-friendly." It is tempting for behavior analysts, especially when talking among ourselves, to criticize those who fail to appreciate or adopt our techniques. In doing so, we violate one of our own fundamental principles: "The subject is always right." If the behavior of adopting a technique is at issue, we are at risk of violating our own principle by criticizing that subject.

Decisions to adopt or reject a given practice can appropriately involve criteria in addition to those of scientific validity, because practices based on scientific principles will not necessarily be better in all respects. For example, although applied chemistry has yielded amazing medicines and materials, it has also yielded extensive pollution of the ground water (Carson, 1962). The "green revolution," which has amplified the productivity of an acre of land, has yielded the by-products of capital- and energy-intensive single-crop agriculture, accompanied by dependence on pesticides and depletion of topsoil (Schumacher, 1973). It is understandable, then, that the public at large may be cautious about adopting our techniques solely on the basis of their being scientifically validated.

My agenda in addressing these issues here is to suggest that, early in the process of developing behavioral interventions, we should be attending to features relevant to their user-friendliness and acceptability, and even to their effects on the extended context surrounding the focus of application. Some strategies for doing this might be aptly characterized as "artfully implemented science" or "scientifically informed art." Art can be utilitarian, as shown by decoration that, throughout recorded history and even before, has been incorporated into useful objects such as those that can be found in most any archaeological museum. In addition, aesthetic pleasure can arise from an object's ease of use. Furthermore, whether one is concerned with arrangements for education or for commercial work, with tools or machines, with artistic painting or with sculpture, a concern with attractiveness and acceptability—which is to say, with aesthetics—need not detract from a first concern with developing and verifying potent procedures with predictable effects. Without this, even in the fine arts, the endeavor can come to naught or worse: Pigments could fade or sculptures could collapse. The innovative art of Alexander Calder's mobiles—massive metal objects that often hang overhead in public spaces—would not have been feasible without Calder's detailed knowledge of basic physics, supported by the reliable skill of welders and other workers who, in turn, depended on the achievements of metallurgical science.

All of this, whether concerned with behavioral interventions or with other applied science, involves the design of arrangements that people will choose to live with. Wolf (1978) addressed these concerns long ago under the label of *social validity,* identifying this with (a) the social significance of a project's goals, (b) the social appropriateness of its procedures, and (c) the social importance of its effects. Citing data derived from clients' ratings of his own programs and those devised by others, he proposed,

> It may be that not only is it important to determine the acceptability of treatment procedures to participants for ethical reasons, it may also be that the acceptability of the program is related to effectiveness as well as to the likelihood that the program will be adopted and supported by others. (p. 210)

I hope to show that some wisdom in these matters, relevant to the domain of behavior, is to be found in disciplines and fields of endeavor outside our own. At the same time, I shall suggest some ways in which these issues and problems can be addressed and understood in terms that derive from behavior analysis. Specifically, a key issue will concern our discriminating between functional and dysfunctional precision in the crafting, the aesthetics, and even the ethics of arranged contingencies.

CATEGORIES OF AESTHETIC CONCERN FOR BEHAVIOR ANALYSTS

The aesthetics of behavior-analytic interventions and practices can readily be divided into three categories: aesthetics of antecedents, of contingencies, and of consequences. The second of these is my main focus, but the other two bear a few observations.

Aesthetics of Antecedents

Relevant antecedents concern the labels and rhetoric that bring (or fail to bring) the public into contact with what we are offering. B. F. Skinner's rhetoric was undeniably effective at gaining public attention, but some of his titles, such as "Why Teachers Fail" (Skinner, 1965) and "Are Theories of Learning Necessary?" (Skinner, 1950), accomplished this in a manner that invited defensiveness, as in the former case, and invited misunderstanding, as in the latter. There have been extensive discussions among behavior analysts regarding whether we need to adhere tightly to our technical terms (e.g., Branch & Malagodi, 1980; Catania, 1991; Deitz, 1986; Morris, Higgins, & Bickel, 1982; Shimp, 1976). My own view is that, for the most part, our terms *per se* are not the main problem. To be sure, the term *punishment* is problematic partly because it has dual, often conflated, meanings in the vernacular, implying vengeance or physical trauma in addition to the more benign meaning that corresponds to our technical usage. *Differential reinforcement* or *discriminative stimulus* may seem arcane and perplexing to nonspecialists. But forbidding terms per se should not be a significant barrier: Neurological explanations of behavior enjoy popular acceptance despite the fact that they invoke technical names of structures, like the amygdala, or of processes, like synaptic transmission. Rather, the tensions between behavior-analytic and vernacular language arise from aspects of language patterns that are far more subtle and problematic than mere choice of terms (Hineline, 1980, 1984, 1988, 1990, 1991, 1992, 2004; Hineline & Wanchisen, 1989). We need to understand these issues in principled ways enabled by our own terms and concepts, rather than merely complaining about *mentalism,* a term that has no particular coherence within behavioral theory. Furthermore, to abandon our careful usage of terms in favor of the vernacular can risk losing the features that make behavior analysis effective, even if it is thus made more acceptable. In the contemporary scene, Wiegand and Geller's (in press) proposed linkage of organizational behavior management with "positive psychology" is an attempt to repackage behavior-analytic applications under more effective antecedents. However, accepting the conflation of *positive* with *good* and then proposing that this is of a piece with the *positive* of *positive reinforcement* invites some serious distortions (Hineline, in press). Although, in most contexts, positive reinforcement is to be preferred over negative reinforcement, pernicious, sociopathic behavior can also be positively reinforced. The label *positive behavioral support* (e.g., see Koegel, Koegel, & Dunlap, 1996) also is an apparent attempt at improving the antecedents that introduce a selected set of behavior-analytic strategies and techniques. The proactive, constructive focus suggested by the word *support* is a promising innovation, but in my view the conflation of *positive* with *good* remains problematic, and the implicit distancing from the conceptual system that provides its basis is rather disingenuous.

Aesthetics of Consequences

The fact that behavior analysts already have been concerned with the aesthetics of consequences can be discerned in several aspects of contemporary behavioral work. Especially effective are strategies that play into existing reinforcers instead of attempting to contrive jazzy ones with no special relation to the behavior of concern. Thus, the strategy of incidental teaching is predicated on the teacher or therapist discriminating when, in the normal ongoing course of events, an event or object is already an effective reinforcer that could be made contingent on the behavior of current concern. A traditional contingency for ensuring that college students will do the assigned reading in preparation for class is to administer frequent quizzes. In contrast, consistent preparation can be ensured by arranging for the students to discuss the readings with each other routinely in well-focused ways; the unobtrusive consequences of informed conversation provide differential reinforcement (Boyce & Hineline, 2002). Ferster (1967) argued strongly for the use of "natural" reinforcers—reinforcers that would be the consequences that would follow directly from the behavior to be established—rather than using arbitrary, contrived reinforcers that depend on a therapist for their delivery. He pointed out that use of contrived reinforcers raises an ethical concern; the behavior being reinforced may be more for the benefit of the therapist or parents than for the individual who is the presumed beneficiary of a therapeutic intervention.

My favorite example of aesthetically arranged reinforcing consequences was achieved by a biologist rather than by behavior analysts. Dagmar Werner, a West German zoologist, found a way for peasants who live in the rainforests of Panama and Costa Rica to engage in "iguana ranching" that entailed the planting of trees instead of the slash-and-burn agriculture that was destroying the ecology of their environment (Boudreaux, 1989). The opportunity for natural reinforcement of the peasants' behavior arose from the fact that iguana lizards are a delicacy in that region—a delicacy that was becoming scarce through the familiar combination of overhunting and destruction of habitat. Werner's innovations began with the design of a device that prompted iguanas to lay their eggs in a specified, guarded location:

> Imitating what she observed in nature, Werner first fashioned a laying nest by burrowing one end of a drainage pipe into an underground chamber of concrete blocks. . . . The morning after she set it in the wild, the nest was filled with eggs. Next, she buried hundreds of eggs in incubators made of Styrofoam ice-chests filled with soil. About 95 percent hatched on the first try. (pp. 1, 10)

Next, Werner demonstrated that when released after growing to modest size in captivity, the lizards do not travel far, and within 3 years of feasting on leaves in the local trees they would provide more high-quality consumable and marketable protein per acre than could be achieved by raising cattle. From that point on, it was a project that required mainly political astuteness to introduce iguana ranching as a cultural practice:

> Werner released thousands of iguanas from her research colony into two rural Panamanian villages in 1986. Farmers were given materials to build cages, nests and incubators plus the counsel of a biologist and a forester. Everything was free except the farmers' labor. Although not yet time to hunt those lizards, "the villagers are absolutely enthused about seeing them multiply and are planting trees like mad," Werner reported. "Nobody burns the forest any more." (p. 10)

At the time of Boudreaux's report, the long-term stability of Werner's innovations was vulnerable to political developments at the national level. This does not detract from the elegance with which the project was dovetailed with natural contingencies that were already operative at the level of the local community.

Finally, in selecting or designing both antecedents and consequences for the arranging of behavioral contingencies, it is important to distinguish between those that are operative for people who might *adopt* the design and those that are operative for people who might *implement* the design on an ongoing basis. All of the above is preamble to my central topic, the aesthetics of contingencies.

CONTINGENCIES AS DISCERNED BY PYE

My initial attempt to "think outside the box" regarding these issues was prompted by reading Pye's (1968) *The Nature and Art of Workmanship.* Pye was a remarkable architect who focused on objects for use at the human scale—tools, furniture, and machines. He carved museum-quality salad bowls instead of designing buildings. Early on, his book is peppered with thought-provoking observations:

> "Good material" is a myth. English walnut is not good material. Most of the tree is leaf mold and firewood. It is only because of workmanship like felling and converting and drying and selection and machining and setting out and cutting and fitting and assembly and finishing—that a very small proportion of the tree comes to be thought of as good material; . . . So it is with all materials. In speaking of good material we are paying an unconscious tribute to the enormous strength of the traditions of workmanship. (p. 2)

> If a designer forces his intentions on workmen who, he knows, are not good enough at their job to carry them out, then he is quite as much to blame for the result at they are. (p. 17)

> The judge, the pianist, and the workman are interpreters. Interpreters are always necessary because instructions are always incomplete: one of the prime facts of human behavior. No drawing, however fully and minutely dimensioned, can ever be more than a sketch as regards the appearance of the thing drawn. . . . the qualities and colours of surfaces, the minute variations of profiles, and still other nuances of shape too tenuous and subtle to describe in practice. (p. 26)

Some of these observations translate quite literally to the design of experimental research or to practical interventions that are focused directly on study of or changes in behavior. But it was in his challenging of conventional distinctions, replacing them with related but different ones, that I found that Pye's discussion prompted new ways of looking at our own work.

One such challenge is built on detailed consideration of how even the simplest of tools is in principle a machine, thus demolishing the commonsense distinction between handmade and machinemade objects. Replacing that distinction is one between *workmanship of risk* and *workmanship of certainty,* with the resulting outcomes of *regulated* versus *free* or even *rough workmanship*. Workmanship of risk may or may not involve sophisticated machinery; both an ax and a dental drill can produce catastrophic damage if used carelessly or unskillfully. Rough versus regulated workmanship is not a distinction between good and bad: If a farmer's fence were crafted with closely fitting dovetailed joints like those in fine furniture, the fence would self-destruct within a few seasons of damp and dry, freeze and thaw. In contrast, a loosely contrived split-rail fence may last a century. In its context, a hand-hewn beam (note that the character of the material is identified by the behavior that shaped it) can be at least as attractive as a beam that has been planed, sanded, and polished. In earlier times, regulated workmanship, being more time consuming to produce, was more expensive than rough workmanship. Today, each is valued when we have a surfeit of the other. A lopsided hand-thrown coffee mug with uneven glaze may cost $20 in a shop that features pleasing objects, whereas the perfectly symmetrical and uniformly finished mass-produced version that can be found in almost any hotel room is valued at a tenth as much.

PLACED AND MISPLACED REGULATION AND DIVERSITY

Thus Pye (1968) reveals the management of variability as a fundamental issue. Good design sometimes involves precision throughout, but more often it involves contrast between regulation and diversity. What is important is to get the precise regulation in the right places. Applied to behavioral situations, a marching band or precision drill team appropriately entails precisely regulated behavior throughout. A team of firefighters must do some things in closely coordinated precision; there is no time to discuss who will hold the ladder, and how. On the other hand, the closely coordinated repertoires must adjust to variations of uneven ground and to the variety of sizes, shapes, and materials of burning buildings. More closely relevant to applied behavior analysis, a lock-step schoolroom designed to require everyone to always behave identically suggests overregulation. Indeed, the portrayal of direct instruction (Engelmann & Carnine, 1982) in ways that imply such overregulation (e.g., Gammage, 1997; Traub, 2002) has contributed substantially to its difficulties of adoption, despite its documented effectiveness (Becker, 1992; Engelmann, 1970). Raspberry (1998) has suggested that the precision that is built into direct instruction can be made more attractive to those who might adopt it by portraying the teacher's role not as that of technician but instead as like that of a classical pianist, because many teachers view themselves as working rather like creatively improvising jazz pianists. In classical piano there are accepted standards of precision; only after those are satisfied is it appropriate to introduce interpretive variation. Still, one needs to identify, in principled ways, the appropriate balance between precision and variation.

Useful Analogies from the Domain of Woodworking

Some relevant relations are well illustrated by close examination of woodworking tools. Examples of this kind are offered here partly because they are well accommodated by the printed page and partly because they arise from my own tangential interests. They are offered partly to encourage readers to examine tangential interests of their own, which might be analogously examined for novel ways to look at behavioral relations.

Figure 1. A draw knife. This woodworking tool is comprised of a sharp blade several inches long, with a handle at each end. It is most readily used to remove thick, irregular shavings; considerable skill is required to produce smooth surfaces with this tool.

Consider first the drawknife—two handles with a sharp blade between (Figure 1). Almost anyone could use one to remove the bark from a branch or log without serious misadventure. Addressed to wood for furniture, implements, or cabinetry, the drawknife is very risky—fast, but likely to result in a rough product. If one takes care not to let it catch in the grain of the wood, though, it can be used to bring a project along efficiently, leaving less to be done with other tools that require slow progress to avoid damage. A skilled worker, having the benefit of an extensive history of contingency-shaped behavior, can use the same tool in producing free but smooth surfaces.

Most of us, being less skilled, would be better off with a tool called a spokeshave (Figure 2). As its name suggests, this one was originally used in producing the wooden spokes of wagon wheels. These days it is used on things like the supporting parts of chairs and stools if they are not to be produced by

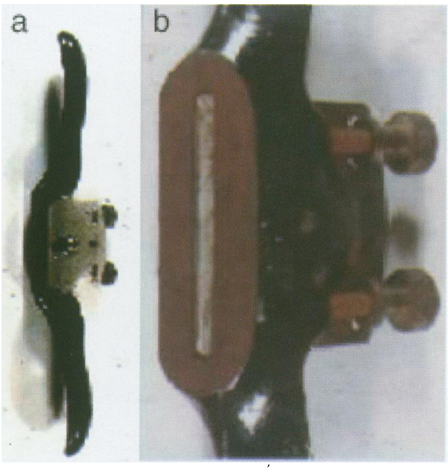

Figure 2. Two views of a modern spoke-shave. The main body of this tool is made of cast iron, supporting a steel blade that is fixed between the handles at each side. As pictured at the right the bottom surface of the tool, where the cutting edge protrudes, has been machined to produce a flat surface that slides along the surface of the wood to be shaved. Two thumbscrews are shown at the top; these assist in adjusting the depth of cut.

Figure 3. Antique spoke-shave. The main body of this tool is made of maple and is honey-brown in color. It is both visually warm and warm to the touch, comfortable to grip.

lathe. The "business end" (middle, actually) of a spoke-shave is similar to a carpenter's plane, having a sharp, straight blade whose depth of cut is rigidly controlled. The modern version is typically made of cast iron, with a handle on each side. Its depth of cut may be adjustable by means of a pair of thumbscrews or by clamping it by trial and error. The handles are cold to the touch, and the tool provides no suggestion of aesthetic pleasure. More crucially, the underside through which the blade protrudes, although appropriately smooth for sliding over the piece to be worked, is typically machined flat, which limits its usefulness (as noted below).

Although it protects the user from making deep cuts in the piece, the modern spoke-shave can be tedious to use. One is obliged to attempt the discrimination, by eye, of the optimal depth of cut, which will vary depending on the particular density and angle of grain in the piece of wood to be worked. Unavoidably, there will be repeated trials and errors, in which the blade often catches in the work, gouging transverse lines that will need to be sanded out—a tedious prospect. A more serious limitation is the flat, planar sliding surface, for this makes the tool useless for working concave shapes. Although grinding that surface flat was an efficient way to manufacture the tool, the flat, planar surface is an example of inappropriately placed regulation.

An antique, mostly wooden spoke-shave illustrates the benefits of appropriately placed regulation (Figure 3). The warmth and soft brown patina of the handles are not readily conveyed by the reproduction presented here, but the important functional characteristics of the tool can be discerned. The surface that slides along the work is curved like a section out of a cylinder with a radius that decreases with proximity to the blade (Figure 4). The result is that one can directly adjust the depth of cut simply by arching one's wrists. The contingent relation between this and the shaving that is carved from the work quickly teaches a person to find the appropriate angle and allows the depth of cut to be adjusted for varying densities and grain angles of the wood to be worked. One can even adjust to

Figure 4. Underside of center portion of antique spoke-shave. The blade uses only a small piece of steel. The bearing surface, which slides along the work, is curved in such a way that the depth of cut can be adjusted simply via the angle at which the tool is held.

Figure 5. A crude antique shaving tool—uncomfortable to grip, and likely to chip and gouge the wood that it is used on.

variations in the grain of a single piece. In addition, this tool is effective on concave as well as on straight or convex shapes. Thus, the antique spoke shave is superior to the modern one in virtually every respect, primarily because of its balance between precise and varied regulation.

This discussion is not in unconditional praise of antique objects, however. Figure 5 shows an antique shaving tool with similar combination of wood and metal that would quickly raise blisters on its user's hands while digging irregular chips from the wood to be worked. Old and primitive is not necessarily beautiful.

Appropriate and Inappropriate, Necessary and Unnecessary, Regulation as Applied to Machines

Although the balance between precise and variable parts may be a subtle matter in the case of simple tools, it becomes more clearly evident when the distinct parts of machines are examined and compared. Of course, some machines require precise regulation, symmetry, and balance throughout. These are relatively rare, however, and involve intense forces and high velocities in multiple dimensions, as in the case of the jet engine. More commonly, regulation is needed only at specific points—the operative points of cutting, bearing, or sliding surfaces, and parts that rotate at high velocity. Pye used the example of a 19th century stationary steam engine with a frame of cast iron that supported highly polished moving parts. However, the same relations can be illustrated by a much more familiar example—the foot-powered Singer sewing machine, which can readily be found in antique shops if not in one's grandmother's house.

The main body of this machine is of cast iron. As suggested by Figure 6, the eye is distracted from its stocky, asymmetrical shape by decorative medallions and leafy designs. Functionally, what matters is its mass (for stability) and its rigidity, supporting two precisely drilled and polished holes at each end. These support the main axle that drives the mechanism. The supporting understructure could be of almost any configuration, provided that it is strong and stable. Cast iron was the usual mode of fabrication, with relatively un-

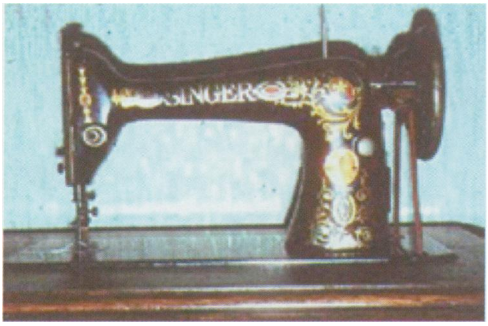

Figure 6. A classic, foot-powered sewing machine.

regulated curves providing decoration while minimizing the amount of material used. Some of the moving parts coordinate with this—the treadle, which is shown most clearly in Figure 7, and the large pulley that it drives, which doubles as a flywheel. Both of these move at low velocity and thus allow for rather free regulation similar to that of the supporting structure (Figure 7).

Figure 7. Understructure of the sewing machine. The sand-cast treadle and drive wheel, which also serves as main flywheel, have rough decoration; the functional features are mainly those of mass and strength. The open pattern of the treadle reduces the amount of material used and minimizes accumulation of dust and dirt.

Returning to the region aboveboard, one finds two areas of precise regulation. The upper flywheel (Part A of Figure 8) has a smoothly polished surface, which is functional because it comes in contact with the operator's hand: The wheel is grasped when the machine is first put into motion, and braking is accomplished by resting the heel of one's hand against the revolving rim. At the other end (Part B of Figure 8) are several moving parts, some of which are hidden from view. The needle, bobbin, foot, and additional moving parts all are machined to close tolerance, highly polished, and closely fitted. It is evident that whoever made this device was capable of very precise work indeed, but reserved the care and expense of that precision for the parts where it was needed.

In contrast, consider Figure 9, which provides a catalogue illustration of a jointer—a machine for smoothing the surfaces of boards that typically is the most dangerous machine in a carpentry shop. Besides the motor, only a few parts require precise regulation: (a) The cutter assembly rotates at high speed, and so must be precisely balanced, and (b) the blades must be straight and smooth. (c) Two flat table surfaces must also be smooth and polished, and the relation between their relative heights, which determines how much wood is removed by the cutters, is precisely controlled by (d) a hand-cranked Vernier device. Everything else could be as free-form as the body and pedestal of a Singer sewing machine. However, as can be seen in the figure, the device is highly regulated throughout. No doubt, it was less expensive to make it that way, and decoration is not a high priority in a cabinetmaker's workshop; one could even argue that the smooth surfaces will gather less sawdust. Nevertheless, the jointer is far less interesting to look at than is the sewing machine.

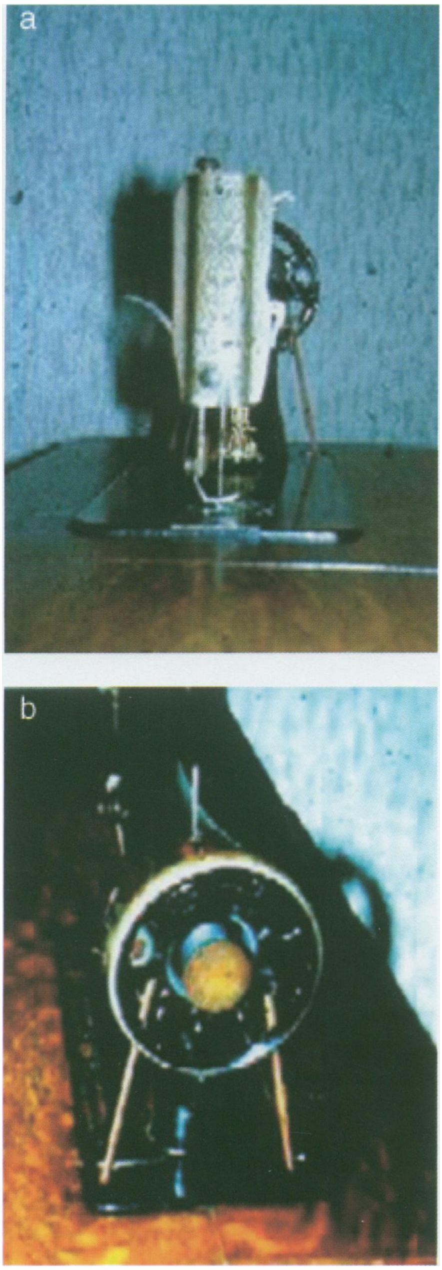

Figure 8. Upper flywheel (Part A) and precise mechanisms (Part B) of the sewing machine. Note that the flywheel is smooth only where it would come into contact with the operator's hand. Although the precise mechanisms are difficult to discern in the photo, the parts in this section of the machine are fabricated to close tolerances. Interestingly, the decoration of the cover at this end is also far more precise than elsewhere on the machine.

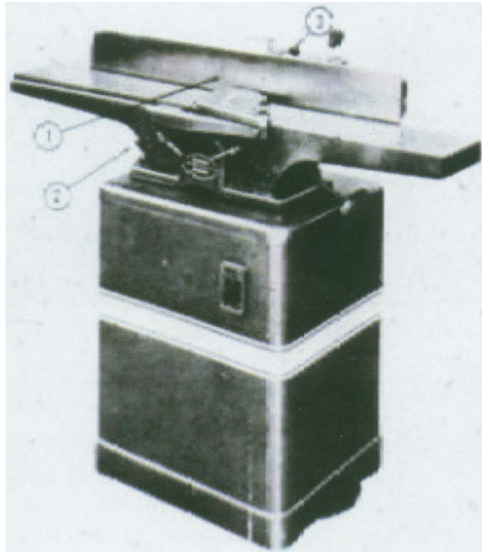

Figure 9. Modern cabinetmaker's jointer. This machine is precisely regulated throughout, irrespective of where precision is relevant to function.

APPLYING PYE'S CONCEPTS AND TERMS TO BEHAVIORAL SITUATIONS

To accomplish analogous analyses of behavioral systems and situations, one needs to identify the equivalent of the sliding, bearing surfaces of a machine. These, then, usually should be specified for precise regulation. The others should be left as loosely regulated as possible, partly because tight regulation is likely to be expensive in terms of staff time or the effort of specification itself. More important, tight regulation where it is not needed is likely to be dysfunctional, generating countercontrol from those directly involved and making it unattractive to those who might select this approach in favor of some other.

For examples with generality, there are many settings in which available staff resources must vary across situations or times of day. For example, it is important for an autistic child's instructional time to be precisely crafted and carefully scheduled with comprehensively specified contingencies that are crucial for the child to acquire and interrelate new repertoires. However, it is seldom feasible—perhaps not even desirable—to sustain the intensity and precision of the teaching contingencies throughout the child's every waking hour. Even though parents and other family members can learn the skills of precise contingency management, it is not realistic to sustain all that precision constantly amid the vicissitudes of the family's daily living. Furthermore, it is desirable to achieve transfer and maintenance of previously acquired repertoires outside the teaching situation. What, then, are the key contingencies that need to be kept in place? Are there some that must be dropped away during maintenance, or that could be forgone during times when caregivers' time must be allocated to household tasks or to siblings? Can the instructional design itself be arranged so that the distinction between crucial and optional contingencies can be easily discerned by those who are to implement them?

A similar concern arises in residential therapeutic settings for individuals with severe behavioral problems. Typically, the staffing levels are reduced during evening "noninstructional" hours, both in numbers as well as in expertise of available staff. It is not unusual for newcomers, and thus the least expert caregivers, to be given the "graveyard shift." Although, to be sure, the night staff will not be called on to undertake new teaching routines, sooner or later situations are sure to arise in which a client's challenging behavior will come to the fore. There also will be features of the client's protocol that must be maintained around the clock. For example, the protocol may specify extinction of a client's obnoxious verbal threats. An inexperienced (or perhaps experienced but not adequately educated) night-staff person may react to a nasty personal insult with "I don't care about the rules—I'm not going to let him get away with that." The specification of "precision" here includes well-focused and effective instruction of staff members, enabling them to discriminate vitriolic inflammatory insults as the extinction bursts and increased variability that are characteristic of behavior undergoing extinction. The precision, then, would be in matching the details of night-staff training with key features of the particular protocols that must be operative both day and night. More generally, the design of procedures to be implemented during the fully staffed periods would best be designed in ways that would not result in the necessity of the night staff to master the entire protocol. Even if they are competent to administer it, the reduced staffing levels may make it unfeasible to do so. Thus, the evening protocols should contain only the most crucial contingencies, and the staff training should reflect a discrimination between these and the ones that can be left imprecise outside of instructional time. Enabling this differentiation will be partly a matter of design and specification of protocols. It may also require precisely focused instruction of staff regarding which procedures matter most, or which procedures are most likely to conflict with the staff person's prior repertoires.

Similar strategies will be relevant in preparing for a client's transitions to less supportive environments. Of course, the prospective environment should be analyzed partly in terms of the repertoires that the new setting will require. In addition, however, the preparation would be facilitated by analyzing the prospective environment in terms of its precise versus its loosely specified contingencies. Is it important that certain things be done on time? Are there specific types of behavior that are likely to result in ridicule? In hostility? In misunderstanding? Equally important, what are the domains of behavior in which variability is accepted or even encouraged?

Considerations of well-placed and ill-placed precision are equally relevant in mainstream educational settings. For example, what should happen when a student asks a question? Precision, here, concerns partly a discrimination among individual students. If the questioner is a shy person who seldom speaks up, one would best react very carefully, for even a rephrasing of the question to improve it could function to punish question asking. An answer that entails correction would best be phrased in as accepting a manner as possible. At the other extreme, if the questioner is a student who frequently expounds on topics extraneous to the matter at hand, a directly critical response may be most effective and appropriate.

What should happen if a student arrives late? Is it practical or aesthetic to apply a consequence to tardiness? Should the situation be designed so that tardiness doesn't matter? In my own teaching I find this one presents a dilemma, because some students come from immediately preceding classes held across campus and others may be contending with the necessity to deliver their children to day care or with the vicissitudes of public transportation. Still, I wish to make optimal use of instructional time. My compromise has been to begin each session with a quick recapitulation of the most important points from the preceding session, thus making the first few minutes important and reinforcing but not absolutely essential for students' success. Those first few minutes are also a good time to discuss topics that are of salient interest to the students, such as strategies for preparing for the final exam.

How tightly must one specify the repertoire to be learned, or the manner of learning? We have relevant strategies and techniques for addressing this—contingency contracts that engage the student in helping to arrange the activity within which the learning will occur and branching programs for computer-based activities.

Can additional work be converted into a basis for reinforcement? It is useful for both student and instructor to have a means of continually monitoring each student's progress. If, early on, one teaches techniques for graphing data, the students can chart their own progress, which can directly reinforce their other work. Once the students have mastered basic techniques, creative variability can be encouraged while precision is maintained where it counts.

I have derived these last few questions from situations close to my own daily work. The same kinds of analyses should be applicable to a wide variety of situations, and each reader knows his or her own circumstances better than I possibly could. Thus, the present essay is an attempt to suggest a principled basis for making new and effective discriminations within your own arrangements, specifically focusing on potentially dysfunctional as well as potentially functional precision and variability.

SUMMING UP

Understandably, the scientific origins of our conceptual system and its techniques led to an engineering, rather than a crafting, emphasis when addressing practical problems. Among other things, this has entailed treating variability of behavior under stable conditions as undesirable and as indicating failure to identify relevant variables. A classic feature of behavior-analytic research has been to track down environmental sources of variability and eliminate them, rather than embracing the variability with statistical analyses (Sidman, 1960). To be sure, premature acceptance of uncontrolled variability can be an unprincipled loss of rigor. On the other hand, sometimes we import into our applications too much of what was needed to initially validate those techniques. Furthermore, contemporary developments in basic research and theory have identified variability as a property of behavior that is functional and adaptive; specific features of variability can function as an operant class, directly selected by contingencies of reinforcement, and can even aid the learning of difficult tasks (Neuringer, 2002).

Finally, as shown by the study of nonlinear recursive systems of calculation (Gleik, 1987), highly unpredictable variability has even been demonstrated to be a property of completely deterministic systems. Novak and Pelaez-Nogueras (2004) have suggested that viewing behavior–environment relations as having such recursive properties that generate chaotic systems is a promising way for behavior-analytic principles to address some of the features of human development. Thus, accepting variability as an adaptive property of behavior with orderly characteristics that include predictable unpredictability is no threat to our metatheoretical scientific assumptions.

Although nurturing variability may sometimes be an appropriate concern, as when shaping and maintaining behavior that qualifies as "creative," a better focus for the design of behavioral contingencies is the discrimination between functional and dysfunctional precision. As Pye amply demonstrated in the domain of fine craftsmanship, "precise versus variable" is not necessarily a distinction between good and bad. Misplaced precision can be needlessly effortful and costly, even ugly.

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